

TABLE 1-continued

No.	Center electrode (mm)	Tip size (mm)	Ground electrode (mm)	L1 (mm)	L2 (mm)	T (mm)	S1 (mm <sup>2</sup> )	S2 (mm <sup>2</sup> )	S1/S2	Ignitability	Wear resistance
13	Φ1.1	2.2 × 2.2	2.7	0.30	0.10	0.40	0.91	4.18	0.22	A	A
14	Φ1.1	2.2 × 2.2	2.7	0.30	0.20	0.40	0.83	4.18	0.20	B	A
15	Φ1.6	1.9 × 1.9	2.7	0.10	0.20	0.40	1.87	3.42	0.55	A	A
16	Φ1.6	1.9 × 1.9	2.7	0.10	0.40	0.40	1.62	3.42	0.47	A	A
17	Φ1.6	1.9 × 1.9	2.7	0.10	0.60	0.40	1.32	3.42	0.39	A	A
18	Φ1.6	1.9 × 1.9	2.7	0.30	0.10	0.40	1.96	3.04	0.64	A	A
19	Φ1.6	1.9 × 1.9	2.7	0.30	0.40	0.40	1.62	3.04	0.53	A	A
20	Φ1.6	1.9 × 1.9	2.7	0.50	0.10	0.40	1.96	2.66	0.74	A	B
21	Φ1.6	1.9 × 1.9	2.7	0.50	0.25	0.40	1.81	2.66	0.68	A	A
22	Φ1.6	2.2 × 2.2	2.7	0.10	0.20	0.40	1.87	4.62	0.40	A	A
23	Φ1.6	2.2 × 2.2	2.7	0.10	0.40	0.40	1.62	4.62	0.35	A	A
24	Φ1.6	2.2 × 2.2	2.7	0.50	0.25	0.40	1.81	3.74	0.48	A	A
25	Φ2.0	2.2 × 2.2	2.7	0.10	0.40	0.40	2.69	4.62	0.58	A	A
26	Φ2.0	2.2 × 2.2	2.7	0.10	0.80	0.40	1.97	4.62	0.43	A	A
27	Φ2.0	2.2 × 2.2	2.7	0.30	0.10	0.40	3.08	4.18	0.74	A	B
28	Φ2.0	2.2 × 2.2	2.7	0.30	0.50	0.40	2.53	4.18	0.60	A	A
29	Φ2.0	2.2 × 2.2	2.7	0.50	0.10	0.40	3.08	3.74	0.82	A	B
30	Φ2.0	2.2 × 2.2	2.7	0.50	0.40	0.40	2.70	3.74	0.72	A	B

[0044] In Table 1, the dimension of the “center electrode” represents a diameter of the end surface 24 of the center electrode 20. The “tip size” represents the dimension of the noble metal tip 31 on the plane perpendicular to the axis O. In each of the samples of No. 1 to No. 30, the shape of the noble metal tip 31 was a square on the plane perpendicular to the axis O. Meanwhile, the shape of a noble metal tip of comparative example (sample No. 0) was a rectangular shape on the plane perpendicular to the axis O. The longitudinal direction of the noble metal tip of comparative example was along the left-right direction on the surface of the sheet in FIG. 2. In Table 1, the dimension of the “ground electrode” represents a dimension, in the width direction, of the ground electrode.

[0045] In Table 1, “L1” represents a distance, along the direction perpendicular to the axis O, from the end surface 36 of the front end portion 33 of the ground electrode 30, to the front end 37 of the noble metal tip 31, as shown in FIG. 2. Further, “L2” represents a distance, along the direction perpendicular to the axis O, from the front end 37 of the noble metal tip 31 to the imaginary straight line CL2. As indicated by the value of L1, in each sample, the noble metal tip 31 projected forward of the front end portion 33 of the ground electrode 30. Further, as indicated by the values of L1 and L2, and the dimension of the center electrode, in each sample except for the sample of comparative example, the end surface 36 of the front end portion 33 of the ground electrode 30 and the front end 37 of the noble metal tip 31 were positioned between the imaginary straight line CL2 and the center line CL1.

[0046] In Table 1, “ignitability” represents the result of the ignitability test for each sample. In the ignitability test, each sample was mounted to an in-line 4-cylinder DOHC engine having a displacement of 1.5 L and using natural air intake. The engine revolution was set as 1200 rpm, and the ignition energy was set as 200 mJ, and an air/fuel ratio (A/F) was maintained as 14.5, and an ignition timing was set as a timing (MBT) at which the torque became maximum, and exhaust gas recirculation (EGR) was performed. An EGR rate at which a torque fluctuation due to the exhaust gas recirculation became 5% was defined as an EGR limit, and the EGR limit was compared with that of comparative

example. Samples each having the EGR limit that was equivalent to or better than that of comparative example are represented as “A” in Table 1. Meanwhile, samples each having the EGR limit that was worse than that of comparative example are represented as “B” in Table 1.

[0047] In Table 1, “wear resistance” represents the result of the wear resistance test for each sample. In the wear resistance test, each sample was mounted to an in-line 3-cylinder DOHC engine having a displacement of 0.66 L and having a supercharger. The engine revolution was set as 3600 rpm, and the ignition energy was set as 200 mJ. After running for 200 hours, the wear volume (reduced volume) of the noble metal tip 31 was compared with that of comparative example. Samples in each of which the wear volume was equivalent to or greater than that of comparative example are represented as “B” in Table 1. Meanwhile, samples in each of which the wear volume was less than that of comparative example by 5% or less are represented as “A”. In other tables described below, samples in each of which the wear volume was less than that of comparative example in a range from more than 5% to 7% or less, are represented as S, samples in each of which the wear volume was less than that of comparative example in a range from more than 7% to 11% or less, are represented as SS, and samples in each of which the wear volume was less than that of comparative example in a range from more than 11% to 15% or less, are represented as SSS, which are not indicated in Table 1. The wear volume of the noble metal tip 31 was calculated by a three-dimensional CT image of the noble metal tip 31 being taken and analyzed.

[0048] Referring to Table 1, in a case where the diameter of the center electrode 20, the tip size, and the distances L1, L2 were variously changed, when the ratio S1/S2 in area was less than 0.22, ignitability was worse than that of comparative example. Meanwhile, when the ratio S1/S2 in area was greater than or equal to 0.22, the ignitability was equivalent to or better than that of comparative example. Further, when the ratio S1/S2 in area was greater than 0.68, wear resistance was equivalent to or worse than that of comparative example. Meanwhile, when the ratio S1/S2 in area was not greater than 0.68, wear resistance was improved as compared to comparative example. That is, the test result indi-